Interactions between Coho Salmon and Warmwater Fish in Western Washington Lakes

Scott Bonar, Bruce Bolding, Marc Divens and William Meyer
Inland Fisheries Investigations
Washington Department of Fish and Wildlife
600 Capitol Way N.
Olympia, WA 98501-1091

Study Rationale and Objectives

Warmwater fish are exotic to the Pacific Northwest, and can prey on and compete with native fish and wildlife (Wydoski and Whitney 1979; Pflug and Pauley 1984; Poe *et al.* 1991; Kane *et al.* 1992; Tabor *et al.* 1993; Curet 1993; Fayram 1996; McMahon and Bennett 1996). Perhaps the interactions currently of most concern in Washington are those with wild salmonids. Some once-abundant salmon runs have declined to such low levels that they are eligible for listing under the Federal Endangered Species Act. Many factors have been blamed for these declines including overfishing, hydropower, urbanization, logging practices, hatchery practices and interactions with exotic species.

To meet these growing concerns, the Washington Department of Fish and Wildlife developed a Wild Salmonid Policy to guide agency efforts in salmon restoration. A part of this policy states that specific steps will be taken to limit the impacts of exotic species on native salmonids. Additionally, an important part of recent warmwater surcharge legislation designed to enhance fishing opportunities for warmwater species is that warmwater fish cannot be enhanced where there may be significant impact to wild salmonids. Knowledge of where and to what extent warmwater fish may be impacting salmonids is vital to the management of both warmwater fish and salmon.

The purpose of our study is to determine the extent and nature of interaction between common warmwater fishes and native anadromous salmon. We have two goals for our study, depending on available funding. They are to (1) estimate the degree of overlap in distribution among various warmwater and salmon species, and (2) estimate the impact of warmwater fish predation and competition on coho salmon migrating through and rearing in Western Washington lakes. We are currently in the first year of our study, so the following provides a brief overview of our goals and methodologies.

Goal 1. Identify the degree of overlap between the distribution of warmwater fish and selected salmon species.

The extent of spatial overlap among various warmwater fish and salmon is important to evaluate the degree of interaction in watersheds statewide. We are investigating the degree of overlap in distribution using geographic information systems (GIS) technology. Gradient and elevation ranges for warmwater species is being obtained from preexisting data and will be truth checked with information from field surveys. This information will be used to develop a GIS overlay of potential warmwater fish distribution by major species in Washington state. Warmwater species overlays will be placed over existing maps of salmon distribution (WDFW, Unpublished Data) to identify areas where overlap may occur.

The products from this work will be: (1) maps of Washington showing areas where the potential exists for various warmwater fish and salmon species to interact; (2) a determination of the extent of this overlap for various salmon stocks; and (3) a prioritization of watersheds on the basis of potential for interaction.

Goal 2. Investigate the extent of warmwater fish predation and competition on coho salmon in three Western Washington lakes.

Within overlap areas, warmwater fish have the potential to affect salmonid populations through

competition and predation. The effects of warmwater predators on salmon populations in the Columbia, Yakima and Snake River systems and two large Western Washington lakes have been studied by several researchers (Pflug and Pauley 1984; Poe *et al.* 1991; Shively *et al.* 1991; Curet 1993; Tabor *et al.* 1993; Burley and Poe 1994; Fayram 1996; McMichael, WDFW Unpublished Data). However, little is known about potential interactions which may occur in the hundreds of smaller lowland lakes in western Washington. Many of these lakes contain warmwater species and provide important juvenile salmon rearing habitat and migration corridors.

We are investigating the extent of predation and competition by warmwater species on coho salmon migrating through and rearing in three Western Washington lakes (William Symington, 32 ha; Wildcat, 44 ha; and Long, 130 ha). Coho salmon smolts pass through these lakes on their migration to the sea, and also use these lakes for rearing areas as fry. These three lakes all have traps on the outlet which are being monitored to enumerate the number of salmon smolts leaving each lake.

The Wisconsin bioenergetics model (Hanson 1997) is being used to estimate the total number of smolt equivalents consumed by piscivores in each lake. This estimate will be then compared to the total number of smolts leaving the lake to estimate degree of smolt loss to both warmwater and coldwater piscivores. Required model inputs are the predator abundance, thermal histories of the waters where predation is taking place, stomach content data, and energy densities of both predators and prey. We are estimating the total number of piscivores (both warmwater and coolwater fishes) in each lake using standard electroshocking, netting, and mark-recapture techniques (Ricker 1975). Feeding habits of the piscivores are being evaluated throughout the year at two week intervals during smolt migration and at monthly intervals throughout the remainder of the year using stomach-flushing techniques and stomach content analysis. All salmon recorded from stomachs are being converted to smolt equivalents. Thermal histories of predators are being obtained from hydrolab data collected in areas where fish were captured. In upcoming seasons, we will investigate food competition between warmwater panfish populations and juvenile salmon.

Products from this study will be (1) an estimate of the number of coho salmon smolts passing through three lakes which are eaten by both warmwater and coldwater piscivores; (2) an estimate of the number of coho salmon smolt equivalents rearing in the lake which are eaten by picivores; (3) that component of fry and smolt picivory which is due to warmwater fish; (4) a comparison of the number of coho salmon removed by predators to the size of the overall run leaving the lake; and (5) a preliminary evaluation as to whether or not food availability is limiting coho salmon rearing in these three lakes.

Literature Cited

Burley, C.C., and T.P. Poe. 1994. Significance of predation in the Columbia River from Priest Rapids Dam to Chief Joseph Dam. Technical Report prepared for Chelan County Public Utility District Number 1; Douglas County Public Utility District Number 1; and Grant County Public Utility District Number 1.

Curet, T.S. 1993. Habitat use, food habits, and the influence of predation on subyearling chinook salmon in Lower Granite and Little Goose Reservoirs, Washington. M.S. Thesis. University of Idaho.

Fayram, A.H. 1996. Impacts of largemouth bass (*Micropterus salmoides*) and smallmouth bass (*Micropterus dolomieui*) predation on populations of juvenile salmonids in Lake Washington. Master's thesis. University of Washington, Seattle.

Hanson, P.C. 1997. Fish bioenergetics 3.0. Computer Model. University of Wisconsin Sea Grant.

Kane, A.S., R.Reimschuessel, and M.M. Lipsky. 1992. Effect of tadpoles on warmwater fish pond production. Fisheries 17(2): 36-39.

McMahon, T.E., and D.H. Bennett. 1996 Walleye and northern pike: boost or bane to Northwest fisheries? Fisheries 21(8):6-13.

Pflug, D.E., and G.B. Pauley. 1984. Biology of smallmouth bass (*Micropterus dolomieui*) in Lake Sammamish, Washington. Northwest Science 58:118-130.

Poe, T.P., H.C. Hansel, S.Vigg, D.E. Palmer, and L.A. Prendergast. 1991. Feeding of predaceous fishes on out-migrating juvenile salmonids in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:405-420.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada Bulletin 191. Ottawa, Canada.

Shively, R.S., R.A. Tabor, R.D. Nelle, D.B. Jepsen, J.H. Petersen, S.T. Sauter, and T.P. Poe. 1991. System-wide significance of predation on juvenile salmonids in the Columbia and Snake river reservoirs. U.S. Fish and Wildlife Service Technical Report. Project No. 90-078.

Tabor, R.A., R.S. Shively, and T.P. Poe. 1993. Predation on juvenile salmonids by smallmouth bass and northern squawfish in the Columbia River near Richland, Washington. North American Journal of Fisheries Management 13:831-838.

Wydoski, R.S., and R.R. Whitney. 1979. Inland fishes of Washington. University of Washington Press, Seattle.